

**Marked-Up Version of Substitute Specification****Description****CAMERA WITH ADJUSTABLE FOCUS****BACKGROUND**

5           The present ~~invention~~ disclosure relates to a camera which can ~~preferably be~~ used in mobile terminals such as, for example, mobile radio devices ~~for example~~.

          Miniaturized cameras are needed for mobile terminals, such as, for example, third-generation mobile radio devices.

          Known cameras are equipped with an adjustable lens. An adjustable lens  
10       requires a complex, mechanical adjustment mechanism. Such mechanical devices are, however, cost-intensive, relatively large and susceptible to mechanical effects such as shocks, and dust, and (wear).

A disadvantage with All ex-works currently manufactured focused cameras (all-fixed-focus systems) have the disadvantage is that the it is cost-intensive to  
15       focusing of the lens during assembly of the camera is a cost intensive business. This also represents the greatest weakness as regards delivery quality for mass production Therefore it is problematic to mass produce such cameras while delivering quality, in a cost effective manner.

          Furthermore, the use of autofocus controls is known for cameras in which  
20       the lens is moved for focusing electrically, magnetically or by a motor. Such controls are, however, susceptible to faults, are not stable, need a great deal of energy and take up a lot of space. However, when the camera is miniaturized for mobile applications As such, it is problematic to provide miniature size cameras incorporating such controls. Therefore it is desirable to integrate autofocus  
25       functionality into ~~the~~ cameras.

**SUMMARY**

          The present ~~invention~~ disclosure ~~is thus based on the object of~~ providing relates to a camera, which can be embodied as a miniature design having,  
30       ~~only has~~ a low power consumption and ~~yet that~~ is not susceptible to mechanical effects, ~~and which.~~ Furthermore, the disclosed camera allows for a hermetically dust-proof construction, with at a low overall costs. In addition, ~~for use in mobile~~

~~terminals, the camera should~~ can be able to be integrated into a housing ~~which that~~ offers sufficient protection against environmental effects for use, for example, in mobile terminals.

5 ~~This object is achieved by a camera with the features of Claim 1. Preferred developments of the present invention are produced by the dependent claims.~~

The camera ~~features~~ apparatus includes a housing, a lens, a sensor as its focal plane, a piezo element for displacing the sensor, and connecting elements for making contact with the sensor. The piezo element is configured and arranged below the sensor, and the lens is mounted in the camera in a fixed way, ~~especially~~ preferably in the camera housing.

10 In a preferred embodiment, ~~of the present invention~~ the focal plane is displaced by the piezo element for focusing. ~~By~~ In contrast with known focusing arrangements, the camera is not focused by moving the lens. The lens can be fixed to the camera housing, ~~where thereby greatly reducing~~ the risk of outside influences being able to affecting the lens ~~can be excluded as much as possible. As such, The~~ housing protects the camera from environmental effects. ~~This can include~~ Such environmental effects ~~such as include, for example, moisture, dust, aerosols, wind, radiation, electrostatic discharges or mechanical shocks.~~

20 ~~For focusing~~ The presently disclosed apparatus uses the reciprocal piezo effect of the piezo element ~~is used~~ for focusing. ~~If~~ When a voltage is applied to a piezoelectric material, the material is mechanically deformed. The piezo element is a piezoelectric material, and is arranged below the sensor. Applying voltage, to cause ~~The mechanical deformation of the piezo element, thereby~~ enables the sensor lying on the piezo element, i.e., the focal plane, to be moved in parallel to the lens. As such, F ~~focusing can e~~ consequently be controlled by moving the focal plane, which ~~dependings~~ on the voltage applied.

30 ~~With t~~ The presently invention disclosed apparatus utilizes a piezo element that can be used to move the focal plane, since a movement of only a few 10 µm, e.g. ± 50 µm, is required for focusing. Consequently, in ~~accordance with an embodiment~~ the invention, a piezo element of known reliability, precision, and stability ~~can be~~ is used. Because ~~P~~piezo elements ~~have the advantage of~~

consuming ~~only~~ relatively little current, ~~and Piezo elements~~ only consume current when the voltage applied to them is changed. ~~At~~ at a constant voltage, practically no current is consumed. The main power consumption is through loss of energy from the current converter. ~~This makes~~ Therefore, in an embodiment, piezo elements ~~the obvious choice~~ are used for mobile applications.

In a ~~preferred~~ another embodiment, ~~of the present invention~~ the connecting elements for making contact with the sensor ~~are embodied as~~ include cables, wires or bond wires. In particular, ~~Wire~~ bonding connections are used ~~in particular.~~ ~~In this case the connecting elements~~ to provide a connection between the sensor and a circuit board or a flexible circuit board or (flex foil).

In accordance with the ~~invention~~ present disclosure, the connecting elements are ~~embodied~~ configured and arranged in such a way that it is possible to move the sensor in parallel to the lens. Contact is made with the sensor in this case on two opposite sides using the bond wires.

The connecting wire is preferably bonded to the sensor. Other connecting options, such as a direct connection of flexible leads between the sensor and the circuit board or connecting flex can be provided ~~(including bonding, gluing or similar)~~ ~~the like of flexible leads between sensor and circuit board/connecting flex can be provided.~~ The bond wires preferably have so much free play that a maximum deformation of the piezo element is not restricted by the cable, and a sufficiently long life of the bond connection remains guaranteed with an active piezo element.

In a ~~further preferred~~ another embodiment, the connecting elements are ~~embodied~~ configured and arranged as at least one flex foil. Preferably, the flex foil consists of a Polyamide substrate with a copper foil cladding and an isolation layer of Polyamide as a covering layer.

In addition, in a preferred embodiment, ~~The~~ flex foil is ~~preferably~~ a thin design: with ~~A~~ a thickness of flex foil of less than 34  $\mu\text{m}$  ~~proves advantageous.~~

~~Preferably~~ In yet another embodiment, the sensor is configured and arranged on the connecting elements.

In a further embodiment of the present ~~invention-disclosure~~, the connecting elements (e.g., a flex foil) feature two elliptical cutouts. ~~and The connecting elements in this case~~ are fixed to the camera housing at the edge, and arranged over the piezo element in the connecting area with the sensor. ~~Embodying Utilizing flex foil as~~ the connecting elements ~~as a flex foil allows low cost and stable contact to~~ be made with the sensor at a low cost. In addition, ~~an optimum functionality~~ of the camera is guaranteed even after a large number of focusing cycles.

In a further embodiment of the present ~~invention-disclosure~~ the camera apparatus features an infrared filter.

Further the camera apparatus can feature a protective glass cover over the lens.

In a further ~~development-embodiment~~ of the present ~~invention-disclosure~~ the camera apparatus is combined with an autofocus control. ~~The present invention~~ ~~Thus, makes~~ autofocusing is possible for such miniaturized cameras. ~~For~~ ~~this is accomplished by using~~ a corresponding algorithm ~~must that~~ takes over the control of the piezo element. Such an algorithm can, for example, be integrated into ~~the~~ an image processor of the camera.

~~The invention is explained in greater detail below with reference to the enclosed drawing on the basis of exemplary embodiments. The features shown in the drawings and also the features already described above can be of importance for the invention not only in the said combination but also individually or in other combinations. The diagrams show:~~

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description and the figures.

## BRIEF DESCRIPTION OF THE DRAWINGS

~~Figure Fig. 1— is~~ a schematic diagram of a camera apparatus in accordance with the ~~invention-present disclosure, with including~~ connecting bond wires;

~~Figure Fig. 2— is~~ a schematic diagram of a camera apparatus in accordance with the ~~invention-present disclosure with including~~ a flexible connection as ~~its the~~ connecting element; ~~and~~.

~~Figure Fig. 3—~~is a diagram of a flex foil ~~in accordance for use~~ with the present invention camera of Fig. 2.

#### DETAILED DESCRIPTION OF THE PRESENT EXAMPLES

~~Figure 1 shows—Referring to Fig. 1, an exemplary~~ embodiment of a camera apparatus ~~in accordance with the invention is illustrated.~~ The camera features a protective glass cover 1, a focusing lens 2 and an infrared filter 3. The lens 2 is fixed to the housing 7 with a frame 14. The lens 2 cannot be moved. ~~The A~~ sensor 4 represents the focal plane. ~~The A~~ piezo element 5, which is located on a circuit board 6, is arranged below the lens. With the aid of the bond wires 10, a connection is provided between the sensor 4, and the circuit board 6. The application of a voltage (not shown) to the piezo element deforms the latter in a vertical direction (as indicated by the arrow) so that the sensor 4 lying on it, i.e., the focal plane of the camera, rises or falls. The camera can thus be focused by changing the voltage ~~at applied to the~~ piezo element 5. The wires 10 can be bonded to the sensor 4 ~~in this case.~~

~~Figure Fig. 2~~ shows a ~~second another~~ exemplary embodiment of the presently invention disclosed camera apparatus. The camera ~~in apparatus of Figure Fig. 2~~ again includes a protective glass cover 1, a focusing lens 2 and an infrared filter 3. The lens 2 is again fixed to the housing 7 via frame 14. Contact with sensor 4 is made ~~in the exemplary embodiment in accordance with Figure 2~~ using a thin flex foil 12. The sensor 4 is on the flex foil 12 in this case. By applying a voltage (not shown) to the piezo element 5, the sensor 4 on the flex foil 12, i.e., the focal plane of the camera, can be raised or lowered. The camera can thus be focused depending on the voltage applied to the piezo element 5.

~~Figure Fig. 3~~ shows a plan view from above ~~in accordance with the invention of the a~~ layout of a flex foil in accordance with the embodiment of Figure Fig. 2. The sensor 4 lies in the central area of the flex foil 11 on the foil. The flex foil 11 features two elliptical cutouts 13. The piezo element (not visible in Fig. 3) is located ~~in~~ the area of the connecting ends 12 of the flex foil 11, i.e., under the sensor 4, ~~the piezo element (not visible in Figure 3) is located. in~~ the edge area of flex foil 11, i.e., around the cutouts 13, the flex foil 11 is connected with the

underside of the housing 7 (not shown). The elliptical ~~embodiment~~ shape of the cutouts 13 is exemplary and not mandatory in this case.

With In all embodiments it is conceivable ~~for to omit~~ the protective glass covers above the lens and/or, depending on the system, also the infrared blocking filter ~~to be omitted~~.

The present ~~invention disclosure also makes it possible to~~ provides adjustable focus in a camera largely protected from environmental effects. Known miniature cameras can ~~in this case~~ therefore be kept the same size, but the field of application ~~of for such cameras is~~ increased.

In addition, ~~there are advantages when~~ the present disclosure relates to the assembling ~~the of such camera apparatus~~, since no small precise fine adjustment tolerances are needed for arranging the lens and only a. ~~A~~ relatively rough adjustment of the lens is ~~sufficient~~ required. The camera can also be focused correctly manually by the user. This has a significant influence on the manufacturing costs of such a camera in series production.

Furthermore, temperature compensation of the focus adjustment can be implemented with such a system. As ~~E~~conventional camera constructions must take account of the effects of the different working temperatures in the construction of the housing, and because ~~T~~this can only be done to a limited extent, or at significant expense, ~~Thus~~ the costs of a camera module can be reduced ~~by the present invention~~.

The presently ~~invention disclosed apparatus~~ can ~~basically~~ be combined with any type of autofocus control, so that autofocus functionality is provided. Better protection against dust is possible by comparison with known autofocus concepts.

It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the present invention and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the appended claims.

## ABSTRACT OF THE DISCLOSURE

The ~~invention~~ present disclosure relates to a camera apparatus comprising a housing-(7), a lens-(2), a sensor-(4) acting as a focal plane, a piezo-element-(5) ~~for to displaing~~ displace the sensor, said piezo-element ~~being positioned below to touch~~ the sensor and ~~connecting connectors elements (10, 11, 12) for to making make~~ contact with the sensors. According to the ~~invention~~ disclosure, the lens is fixedly mounted ~~in the camera, in particular in the camera to the~~ housing ~~in a fixed manner~~. In a preferred embodiment, the focal plane is displaced by the piezo-element ~~in order to~~ adjust the focus.

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of claims:**

Claims 1-15 (cancelled)

5           Claim 16 (New) A miniaturized camera apparatus including a housing comprising:

          a housing;

          a lens fixedly mounted to the housing;

          a sensor configured as a focal plane of the lens;

10           a piezo element configured to displace the sensor, wherein the piezo element is disposed touching the sensor; and

          connectors configured to make contact with the sensor, wherein the connectors include at least one flex foil and two cutouts.

          Claim 17 (New) The camera apparatus as defined in claim 16, wherein the  
15           a focal plane is displaced by the piezo element.

          Claim 18 (New) The camera apparatus as defined in claim 16, wherein the connectors are selected from the group consisting of cables, wires, and bond wires.

          Claim 19 (New) The camera apparatus as defined in claim 18, wherein the connectors provide a connection between the sensor and a circuit board.

20           Claim 20 (New) The camera apparatus as defined in claim 19, wherein the circuit board is selected from the group consisting of a standard circuit board, a flexible circuit board, and a flex foil.

          Claim 21 (New) The camera apparatus as defined in claim 16, wherein connectors are configured to allow the sensor to move parallel to the lens.

25           Claim 22 (New) The camera apparatus as defined in claim 16, wherein the sensor is arranged on the connectors.

          Claim 23 (New) The camera apparatus as defined in claim 16, wherein the cutouts are elliptical in shape.

30           Claim 24 (New) The camera apparatus as defined in claim 16, wherein an edge area of the connectors is attached to the housing.



Claim 25 (New) The camera apparatus as defined in claim 16, wherein the connectors are disposed in a connecting area with the sensor.

Claim 26 (New) The camera apparatus as defined in claim 16, further comprising an infrared filter.

5        Claim 27 (New) The camera apparatus as defined in claim 16, further comprising a protective glass over the lens.

Claim 28 (New) The camera apparatus as defined in claim 16, wherein the housing is configured to protect the camera apparatus against environmental effects.

10        Claim 29 (New) The camera apparatus as defined in claim 16, further comprising:

an image processor including an algorithm that effects autofocus control of the camera apparatus.

## REMARKS

The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States patent practice. No new matter is added. Included is a Substitute Specification including a marked-up version of the changes made via the present amendment.

In addition, the present amendment cancels original claims 1-15 in favor of new claims 16-29. Claims 16-29 have been presented because revisions by red-lining and underlining which would have been necessary in claims 1-15 in order to present these claims in accordance with preferred United States patent practice would have been too extensive, and, thus, too burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§101, 102, 103 or 112. Indeed, the cancellation of claims 1-15 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-15.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

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